

Part 2: Activities of the Broker-Dealer Operator and its Affiliates

Item 2.5: Other Products and Services

Does the Broker-Dealer Operator offer Subscribers any products or services for the purpose of effecting transactions or submitting, disseminating, or displaying orders and trading interest in the NMS Stock ATS (e.g., algorithmic trading products that send orders to the ATS, order management or order execution systems, data feeds regarding orders and trading interest in, or executions occurring on, the ATS)?

Y

If yes, identify the products or services offered, provide a summary of the terms and conditions for use, and list here the applicable Item number in Part III of this form where the use of the product or service is explained. If there is no applicable Item in Part III, explain the use of the product or service with the ATS here.

OneChronos Markets, LLC, the Broker-Dealer Operator ("Operator") of the ATS, provides a ~~web-based system ("Portal") for supplemental service called the "Expressive Bidding Service" that is available to~~ Subscribers, ~~and non-Subscribers (e.g. as well as to~~ institutional investors, ~~that may submit orders to the ATS indirectly through Subscribers, such as~~ hedge funds, principal trading firms, etc.) ~~who can direct orders to the ATS through a Subscriber.~~ (collectively ~~known as~~, Subscribers and other users of this service are "External Users"). ~~The Portal allows~~ An External User accesses the Expressive Bidding Service through a web-based system ("Portal") and may use this service to construct, and analyze, ~~and submit~~ customizable execution constraints ("Bidder Logic") ~~to the ATS~~ for use with a type of multi-part order permitted by the ATS known as ~~the Computational~~ an Expressive Order (described in detail in Part III Item 7). ~~The Portal cannot be used to transmit any orders to the ATS.~~

We use the term "Subscriber" throughout this ATS-N to refer to a broker-dealer that is authorized by the Operator to submit orders, including Expressive Orders, directly to the ATS. Only an External User that is a Subscriber may send an Expressive Order directly to the ATS. Other External User are not authorized to send Expressive Orders directly to the ATS for execution, and may only do so through, and as a customer of, a Subscriber. Such an External User may direct a Subscriber to send an Expressive Order on its behalf to the ATS, using the External User's specified Bidder Logic. For the limited purpose of accessing the Expressive Bidding Service, such an External User is a "subscriber" of that service for purposes of SEC Regulation ATS, even though it is not a Subscriber that is authorized to submit orders to the ATS.

Access to the Portal is available to all External Users that agree to the Operator's terms of service. The Bidder Logic functionality available within the Portal is the same for all such External Users. As described in Part III Item 7, the Portal provides tools for testing, analyzing, and submitting Bidder Logic.

Upon request, the Operator provides technical support and guidance related to interaction with the ATS (e.g. connectivity, usage of order types, and construction and management of Bidder Logic).

If yes to Item 5(a), are the terms and conditions of the services or products required to be identified in Item 5(a) the same for all Subscribers and the Broker-Dealer Operator?

Y

If no, identify and explain any differences.

Does any Affiliate of the Broker-Dealer Operator offer Subscribers, the Broker-Dealer Operator, or both, any products or services for the purpose of effecting transactions or submitting, disseminating, or displaying orders or trading interest in the NMS Stock ATS?

N

If yes, identify the products or services offered, provide a summary of the terms and conditions for use, and list here the applicable Item number in Part III of this form where the use of the product or service is explained. If there is no applicable item in Part III, explain the use of the product or service with the ATS here.

If yes to Item 5(c), are the terms and conditions of the services or products required to be identified in Item 5(c) the same for all Subscribers and the Broker-Dealer Operator?

If no, identify and explain any differences.

Item 2.7: Protection of Confidential Trading Information

Describe the written safeguards and written procedures to protect the confidential trading information of Subscribers to the NMS Stock ATS, including:
i. written standards controlling employees of the ATS that trade for employees' accounts; and ii. written oversight procedures to ensure that the safeguards and procedures described above are implemented and followed.

The Operator maintains Written Supervisory Procedures ("WSPs") that govern the use of Confidential Trading Information.

The Operator classifies as Confidential Trading Information: orders and order handling instructions, executions, clearing reports, non-tape TRF reports, risk configurations, and Bidder Logic (as described in Part II Item 5). The commingling of data that would otherwise not be considered confidential, for example, raw FIX messages appearing in application performance logs, with Confidential Trading Information is also treated as Confidential Trading Information. Individuals with access to a system that stores or processes Confidential Trading Information are considered to have access to that information.

ACCESS TO AND USE OF CONFIDENTIAL TRADING INFORMATION: The Operator's activities as a broker-dealer are limited to operation of its alternative trading system. Operator employees operating the ATS may have access to Confidential Trading Information. A Series 24 registered supervisor ("ATS Supervisor") ensures the ATS restricts access to Confidential Trading Information to employees who are operating the ATS, those whose roles require access to such information for performing their duties, or those responsible for the Operator's compliance with Reg ATS and other applicable rules, as further described in Part II Item 7(c) below.

Operator personnel with access to Confidential Trading Information are only authorized to use such information as required by their job functions. They cannot disseminate such information to anyone not authorized to receive that information. The Operator requires all employees, including those with authorized access to Confidential Trading Information, to undergo annual compliance training that includes instruction and attestation relating to the protection of Confidential Trading Information.

The Operator performs at least quarterly reviews to confirm that those employees with access to Confidential Trading Information continue to have a valid need to access such information, as described under KEY SECURITY CONTROLS below.

KEY SECURITY CONTROLS: The Operator employs a broad range of security controls to protect trading systems and Confidential Trading Information. The principal controls are as follows:

- 1) **Centralized identity management:** The Operator maintains a central repository of user accounts for Operator personnel ("Internal Users"), which may include temporary contractors hired by the Operator as well as employees of the Operator. The Operator also maintains a central repository for all Subscribers and other External Users

accessing the Portal described in Part II Item 5. Only an ATS Supervisor or a designee can establish new accounts for Internal Users or External Users. Internal Users may only access Confidential Trading Information if their accounts have been authorized, as discussed in the “Authorization” section in paragraph (3) below;

- 2) Authentication: The Operator requires the use of strong passwords meeting specified length and complexity requirements for all authenticated internal and external systems and services. Systems require multi-factor authentication whenever possible. Anti-brute-force mechanisms such as request throttling, IP whitelisting and blacklisting, account lockouts, and the use of cryptographic hashing help protect user credentials against both online and offline attacks;
- 3) Authorization: The Operator uses Role-based access control (“RBAC”) to manage access to resources and systems for both Internal and External Users. In an RBAC process, categories of Roles are identified. Persons in particular Roles are given defined access to specific systems and resources, and thereby to specific categories of Confidential Trading Information. Accounts of specific Internal Users and External Users are granted Roles. Those Accounts can then only access a system or resource to the extent that their configured Roles allow the access. For example, an Internal User in the Operations area who requires routine access to cleared transaction information, but not to “live” orders, would be assigned an Account for which the Role was configured to deny access to live order information. A Subscriber External User would only have access to information related to its orders and transactions, and not to that of other Subscribers. The “principle of least privilege” dictates what Roles are appropriate for a given Account. The Operator’s CCO or a designee of the CCO conducts periodic (at least quarterly) audits of Roles and their assignments to Accounts. These audits analyze the current and expected job functions of Operator personnel, the Roles configured for their Accounts, and whether the systems, data, and other resources accessible through those Roles are necessary for those personnel to perform their job functions. As personnel responsibilities change, e.g. through assignments to new positions or due to systems or processes re-design, the CCO or designee would assess the (continued) need for those personnel to access specific kinds of Confidential Trading Information, and, as a result, the CCO or designee may require a change in Accounts or re-configuration of Roles;
- 4) Encryption: the Operator requires the use of strong encryption for data in transit over any untrusted network. Transmission of unencrypted data is not permissible unless a physical security model, e.g. a private cross connect between a Subscriber and an Operator trading system, provides comparable security guarantees. Media encryption protects Confidential Trading Information (as defined in Part II Item 7(d)) as part of the nightly archival process;
- 5) Physical Security: all production ATS trading systems are hosted in a SOC (System and Organization Controls) certified facility (described in Part II Item 6) which employs strong security controls, such as: surveillance, physical barriers, armed security, and multi-factor access controls. This facility maintains fully redundant HVAC and power

systems to reduce the risk of outages and business interruptions. Control of production trading systems happens over a physically secured private network;

- 6) **Change Management:** The Operator employs a rigorous change management process for changes to all of its production systems, including the trading systems described in Part III and the Portal described in Part II Item 5 (“Production Systems”). Any proposed changes to Production Systems are analyzed by a designated “Change Team” for: software and/or configuration integrity; adherence to regulatory requirements and disclosures; impact on systems, operations, and practices; changes to External User-facing elements; and adherence to policies and procedures. These reviews include an assessment of the impact of the change on Confidential Trading Information, including how it is processed and stored, access to the information by Internal Users and External Users, and possible vulnerability to unauthorized access or misuse. The Change Team includes senior management of the Operator and ATS System, Business Development and Compliance managers;
- 7) **Monitoring:** the ATS uses a combination of proprietary and commercial software that monitors: a) trading system status, utilization, connectivity, and message rates; b) anomalies in trading data (orders, executions, reports, market data); and c) centrally aggregated system and application log data for anomalous events and unauthorized access to critical systems and systems containing Confidential Trading Information;
- 8) **Incident Management:** The Operator maintains a documented incident response process identifying steps to investigate and remediate security incidents, and a list of designated emergency contacts to alert upon detection of a security incident;
- 9) **Third Party Risk Assessment:** The Operator maintains a list of third-party suppliers with whom it conducts business. Before integrating any new third-party supplier, the Operator conducts a risk assessment that analyzes a) the type and classification of data that third party may access, and b) the potential threats to that data. For any third parties that have access to or may reasonably receive access to Confidential Trading Information, the risk assessment includes a thorough review of the third-party’s security controls, business continuity controls, data protection and privacy practices, policies and procedures. These reviews focus on the ability of the third party to protect the confidentiality, availability, and integrity of Confidential Trading Information at each point where such information is stored or processed;

ATS EMPLOYEES’ TRADING ACTIVITY: In accordance with FINRA Rule 3210 employees of the Operator must report to the CCO all personal investment accounts, as well as related accounts (those of immediate family members residing with the employee or to whom the employee provides material financial support, or other accounts the employee controls). These reports must be made to the CCO within 30 days of commencing employment or promptly upon opening a new account. Employees are strictly prohibited from trading on firm proprietary information, Confidential Trading Information, other confidential ATS External User information, and material non-public information (“MNPI”). The CCO surveils employee personal and related accounts for activity that may be indicative of possible abuses or violations of federal securities law, including those proscribing insider trading,

which may include, as examples, excessive trading activity, activity that departs materially from typical activity in the account under review, or unusual trading activity in securities of a company with breaking news in the press. Operator employees operating the ATS may have access to External User orders and trading information; those and other employees described in Part II Item 7(d) may have access to information about Subscriber trading strategies and objectives. All Operator personnel are strictly prohibited from using any such information to their personal advantage. Annual compliance training includes materials and an attestation relating to employee trading activity, trading activity with regards to Confidential Trading Information, and identification, escalation and misuse of MNPI. The CCO reviews trade confirmations, ex-post, and account statements received from broker-dealers where employees hold accounts on a monthly basis. Patterns of activity, as exemplified above, that may be indicative of insider trading or misuse of confidential data, including External User Confidential Trading Information, are subject to further scrutiny and escalation.

Can a Subscriber consent to the disclosure of its confidential trading information to any Person (not including those employees of the NMS Stock ATS who are operating the system or responsible for its compliance with applicable rules)?

N

If yes, explain how and under what conditions.

If yes to Item 7(b), can a Subscriber withdraw consent to the disclosure of its confidential trading information to any Person (not including those employees of the NMS Stock ATS who are operating the system or responsible for its compliance with applicable rules)?

If yes, explain how and under what conditions.

Provide a summary of the roles and responsibilities of any Persons that have access to confidential trading information, the confidential trading information that is accessible by them, and the basis for the access.

Operator personnel responsible for the day-to-day operation of the ATS have access to Confidential Trading Information to the extent that their responsibilities require it, as provided by the RBAC process described in Part II Item 7(a). The following personnel are authorized to access Confidential Trading Information:

- 1) ATS Operations staff, who require access to all forms of Confidential Trading Information, e.g. for market surveillance, analysis, and customer support;
- 2) ATS Engineering staff, who require access to historical order and execution data, e.g. for development of ATS matching systems and analysis of ATS matching performance as described in Part III Item 11;

- 3) Operator Supervisory and Compliance staff, who require routine access to Confidential Trading Information in summary form, e.g. for market surveillance and investigation of any errors or anomalies, and may require non-routine access to more detailed Confidential Trading Information in the investigation or analysis of particular events, activities or Users;
- 4) Sales staff, who require access to Confidential Trading Information in summary form, e.g. for analysis of ATS participation and liquidity properties. Individuals who do not have access to specific subsets of Confidential Trading Information, e.g. sales staff who are asked by a Subscriber for assistance in evaluating the efficacy of Bidder Logic used in constructing ~~Computational~~Expressive Orders, may request access from an ATS Supervisor or designee on an as-needed basis.

Persons from third-party service providers, as listed in Part II Item 6, that support the ATS including clearing and settlement and data center support technicians may have access to Confidential Trading Information. Such access is permitted solely on an as-needed basis and with limited scope, subject to the evaluation and audit procedures for third-party vendors described in Part II Item 7(a). As part of the quarterly audit process described under KEY SECURITY CONTROLS in Part II Item 7(a), the Operator will review the type and scope of access of third-party service providers to Confidential Trading Information. As part of the review, the Operator confirms those providers continue to have a valid need to access such information.

Part III: Manner of operations

Item 3.1: Types of ATS Subscribers

Select the type(s) of Subscribers that can use the NMS Stock ATS services:
Investment Companies; Retail Investors; Issuers; Brokers; NMS Stock ATSs;
Asset Managers; Principal Trading Firms; Hedge Funds; Market Makers; Banks;
Dealers; Other If other, identify the type(s) of subscriber.

Brokers

Dealers

Other

If other, identify the type:

Institutional Investors as External Users that are authorized to use the Operator's Expressive Bidding Service only; such persons are not authorized to access the ATS directly to submit orders.

Item 3.2: Eligibility for ATS Services

Does the NMS Stock ATS require Subscribers to be registered broker-dealers?

Y

Are there any other conditions that the NMS Stock ATS requires a Person to satisfy before accessing the ATS services?

Y

If yes, list and provide a summary of the conditions.

Applicants ~~must be registered broker-dealers in good standing with the Securities and Exchange Commission~~ to be a Subscriber to access the ATS directly for submitting orders must be duly registered under the Securities Exchange Act of 1934 with the SEC as a broker-dealer and in good standing; a member of FINRA or (only if it does not have customers) a member of an exchange that is registered with the SEC as a national securities exchange; and registered and/or qualified in those states and other jurisdictions where its business requires such registration and/or qualification. Applications must be satisfactorily complete and include the following documents for consideration:

- 1) ~~-1-~~ Subscriber Agreement;
- 2) ~~-2-~~ Portal Terms of Service Addendum to the Subscriber Agreement (required only if using Portal described in Part II Item 5);

- 3) ~~3) Current signed Form BD, together with schedules and reporting pages; 4) Form U4s for each officer, director and equity holder who holds a 5% or greater equity interest in the Applicant, if not available on FINRA's WebCRD; 5) The Applicant's most recent annual FOCUS report and annual audited financial report; 6) Attestation of electronic filing of NSCC Form 9-A, 9-B, Attachment #1;~~
- 4) ~~7) FINRA Uniform~~ Service Bureau/Executing Broker Agreement; ~~8) Service Bureau~~ Reporting Agreement;

To receive initial approval and maintain access as a Subscriber, broker-dealer applicants must meet and maintain the following requirements:

- a) ~~a) Applicants must complete all application materials, as set forth above;~~
- b) ~~b) Applicants must be self-clearing, or clear through another broker-dealer, supplying information detailing their clearing relationship as prescribed above. Operator reserves the right to confirm the standing of the applicant, its clearing broker and the adequacy of clearance and settlement arrangements, with the applicant's clearing broker, NSCC, DTC or other registered clearing agency, as applicable;~~
- c) ~~c) Subscribers must remit all applicable payments on a timely basis;~~
- d) ~~d) Subscribers must meet the technical requirements prescribed by the Operator, including but not limited to connectivity certification and verification of a Subscriber's ability to send orders and cancellations and receive execution reports as well as unsolicited cancels;~~
- e) ~~e) Subscribers must have executed and not terminated the OneChronos Subscriber Agreement;~~
- f) ~~f) Subscribers must attest to having read the OneChronos Subscriber Handbook and OneChronos Subscriber Usage Policies and Procedures, and certify in writing that they agree to abide by them;~~ g) Subscribersits personnel must otherwise remain in compliance with their obligations as set forth in the Subscriber's Agreement, Subscriber's Handbook and Subscriber Usage Policies and Proceduresthe OneChronos User Manual (found on its public website), and other policies and procedures of which Subscriber is notified in writing by OneChronos reasonably in advance of effectiveness.

Eligibility to Access the Supplemental Expressive Bidding Service:

External Users may access the Expressive Bidding Service as described in Part II Item 5(b). A Subscriber is not required to use the Expressive Bidding Service but may elect to use this service by agreeing to the Operator's terms of service set forth in an optional addendum to the subscriber agreement. The Expressive Bidding Service is also available to any institutional investor (e.g., hedge funds, principal trading firms) as an External User if such person agrees to the Operator's terms of service set forth in an agreement developed for use with such External Users.

An External User may submit its specific Bidder Logic ("Submitted Bidder Logic") to reside within the ATS through the Portal. Submitted Bidder Logic submissions are NOT orders themselves, and the Portal itself may not be used to submit any orders to the ATS. In addition, only Subscribers may submit orders directly to the ATS for execution.

A person's Submitted Bidder Logic represents conditionality that may be attached to an order submitted to the ATS (termed a "Target Order") for execution. Subscribers may submit Target Orders that reference Submitted Bidder Logic to the ATS; the combination of the Target Order and referenced Submitted Bidder Logic is referred to as an "Expressive Order." Expressive Orders are always submitted to the ATS via FIX protocol. External Users that are not Subscribers cannot establish FIX connections to the ATS and cannot directly enter Expressive Orders into the ATS. Such an External User may instead direct a Subscriber with which it has established a customer relationship to submit an Expressive Order on its behalf that references the External User's Submitted Bidder Logic. As explained in Part 2 Item 5, the term "Subscriber" is used throughout this ATS-N to refer to a broker-dealer that is authorized by the Operator to submit orders to the ATS, but for the limited purpose of accessing the Expressive Bidding Service, an External User that is not a Subscriber within that meaning is considered a "subscriber" of the Expressive Bidding Service for purposes of SEC Regulation ATS.

If yes to Item 2(b), are the conditions required to be identified in Item 2(b) the same for all Persons?

Y

If no, identify and describe any differences.

Does the NMS Stock ATS require Subscribers to enter a written agreement to use the ATS services?

Y

Item 3.3: Exclusion from ATS services

Can the NMS Stock ATS exclude, in whole or in part, any Subscriber from the ATS services?

Y

If yes, list and provide a summary of the conditions for excluding, in whole or in part, a Subscriber from the ATS services.

The Operator approves and denies Applicants to be Subscribers in its sole discretion. The Operator may reject Applicants and terminate Subscriber Agreements, Portal Terms of Service, or both if, for example, an Applicant or Subscriber is charged with, or is determined to have committed, material violations of the federal securities laws, FINRA rules, or other relevant rules or regulations, or is deemed by Operator to have engaged in conduct or activities that may be materially detrimental to the operation of the ATS, the reputation of the Operator or the ATS, or the interests or well-being of other Subscribers or External Users of the ATS.

If Operator personnel become aware of issues related to a Subscriber's participation in the ATS regarding any of the criteria set forth above in Part III Item 2(b) they may bring those issues to the attention of the ~~Registered Principal responsible for business development, or to another member of the~~ team responsible for review of new and ongoing Subscribers ("Application Review Team"; which consists of a Registered Principal of the Operator, a Business Development person, and such other personnel as the Operator may designate). If deemed necessary the Application Review Team may convene and determine whether a Subscriber is still eligible for access in light of new information, and if their continued access jeopardizes the well-being of the ATS or other Subscribers. The Application Review Team may take actions including the termination of a Subscriber Agreement or the imposition of restrictions on a Subscriber's activities. If the Application Review Team concludes that action is necessary, they will document the material facts and actions taken before communicating them to the Subscriber via a Registered Principal of the Operator.

If an application is denied, approved subject to terms and conditions, a Subscriber Agreement is terminated, or a Subscriber's activities are restricted, the applicant or Subscriber may request a written explanation of the determination made by the Operator. Upon receiving the Operator's written explanation, the Applicant/Subscriber will have 30 calendar days to respond or otherwise cure that which is the cause of the denial, termination, limitation or restriction of services.

The same criteria identified in Part III Item 3(a) for termination or limitation of Subscriber Access would also be used in considering whether to limit or terminate External User access to the Portal.

If yes to Item 3(a), are the conditions required to be identified in Item 3(a) the same for all Subscribers?

Y

If no, identify and explain any differences.

Item 3.5: Means of Entry

Does the NMS Stock ATS permit orders and trading interest to be entered directly into the ATS (e.g., via Financial Information eXchange (FIX) protocol, Binary)?

Y

If yes, explain the protocol that can be used to directly enter orders and trading interest into the ATS.

The ATS is designed to accommodate multiple points of presence ("Points of Presence", "PoP", "PoPs") for order entry. Only Subscribers ~~can~~may directly submit orders to the ATS, and may only do so by establishing a connection via FIX (4.2) protocol at a PoP maintained by the Operator. Currently, the Operator maintains a single PoP at Equinix NY5. Such orders are time-stamped then transmitted to the (centralized) matching engine location at Equinix NY5. Further information on the PoP model follows in Part III Items 5, 6 and 11. No other order entry protocols are available.

ORDER AND BIDDER LOGIC SUBMISSION:

External Users ~~other than Subscribers (e.g. institutional investors seeking to direct orders to the ATS using the services of a Subscriber)~~ cannot submit orders directly to the ATS ; ~~they must direct orders through the Portal. In addition, only a Subscriber. Such may submit orders to the ATS.~~ External Users, ~~however, can directly~~may submit their Submitted Bidder Logic to the ATS through the Portal. ~~Subscribers may enter Bidder Logic either through FIX messages or through the Portal, but such Submitted Bidder Logic submissions are NOT orders themselves. Rather, they are reliant on subsequent orders (which are termed "Target Orders") to effect transactions in the ATS. Orders are always received by the ATS from Subscribers, and are always received via FIX protocol.~~

An External User's Submitted Bidder Logic represents conditionality that are not themselves Subscribers (e.g. institutional investors) cannot establish FIX connections to the ATS and cannot directly enter orders into the ATS. To enter orders into the ATS, including may be attached to an order submitted to the ATS (termed a "Target Order") for execution. Subscribers may submit Target Orders that are to be used as part of a Computational Order, non-Subscriber reference Submitted Bidder Logic (the combination of which is the "Expressive Order") to the ATS via FIX protocol. An External Users must send orders destined for the ATS to User that is not a Subscriber may direct a Subscriber with which they have it has established a customer account. Non-Subscriber External Users may have customer accounts with more than one Subscriber relationship to submit an Expressive Order on its behalf that references the External User's Submitted Bidder Logic.

If yes to Item 5(a), are the protocols required to be identified in Item 5(a) the same for all Subscribers and the Broker-Dealer Operator?

Y

If no, identify and explain any differences.

Are there any other means for entering orders and trading interest into the NMS Stock ATS (e.g., smart order router, algorithm, order management system, sales desk)?

N

If yes, identify and explain the other means for entering orders and trading interest, indicate whether the means are provided through the Broker-Dealer Operator, either by itself or through a third-party contracting with the Broker-Dealer Operator, or through an Affiliate of the Broker-Dealer Operator, and list and provide a summary of the terms and conditions for entering orders or trading interest into the ATS through these means.

If yes to Item 5(c), are the terms and conditions required to be identified in Item 5(c) the same for all Subscribers and the Broker-Dealer Operator?

If no, identify and explain any differences.

Item 3.7: Order Types and Attributes

Identify and explain each order type offered by the NMS Stock ATS. In your explanation, include the following:

- i. priority, including the order type's priority upon order entry and any subsequent change to priority (if applicable); whether and when the order type can receive a new time stamp; the order type's priority vis-a-vis other orders on the book due to changes in the NBBO or other reference price; and any instance in which the order type could lose execution priority to a later arriving order at the same price;
- ii. conditions, including any price conditions (e.g., how price conditions affect the rank and price at which it can be executed; conditions on the display or non-display of an order; or conditions on executability and routability);
- iii. order types designed not to remove liquidity (e.g., post-only orders), including what occurs when such order is marketable against trading interest on the NMS Stock ATS when received;
- iv. order types that adjust their price as changes to the order book occur (e.g., price sliding orders or pegged orders) or have a discretionary range, including an order's rank and price upon order entry and whether such prices or rank may change based on the NBBO or other market conditions when using such order type; when the order type is executable and at what price the execution would occur; whether the price at which the order type can be executed ever changes; and if the order type can operate in different ways, the default operation of the order type;
- v. whether an order type is eligible for routing to other Trading Centers;
- vi. the time-in-force instructions that can be used or not used with each order type;
- vii. the circumstances under which order types may be combined with another order type, modified, replaced, canceled, rejected, or removed from the NMS Stock ATS; and
- viii. the availability of order types across all forms of connectivity to the NMS Stock ATS and differences, if any, in the availability of an order type across those forms of connectivity.

STANDARD ORDER TYPES: The ATS supports the following "Standard Order" types:

- 1) "Limit Order": an order which (if filled) executes at or above (for an order to sell) or at or below (for an order to buy) the User specified price. Limit Orders must include a security (symbol), a side (buy or sell), a limit price, and a maximum quantity (shares);
- 2) "Midpoint Peg Order": a type of Limit Order which (if filled) executes at the midpoint of the NBBO (or better). Determination of the NBBO and midpoint price follows in Part III Items 11 and 23. Midpoint Peg Orders must include a security (symbol), a side (buy or sell), and a maximum quantity (shares). Midpoint Peg Orders can also include a

price limit such that the order will not execute if the computed midpoint price is higher (buy) or lower (sell) than the specified limit.

~~COMPUTATIONAL~~~~EXPRESSIVE~~ ORDERS: The ATS also supports ~~Computational~~~~Expressive~~ Orders, an order type unique to OneChronos that allows Subscribers or other External Users entering Bidder Logic to specify execution instructions spanning one or more individual Limit Orders, including Midpoint Peg Orders. Any Limit Order or collection of Limit Orders referencing Bidder Logic receives treatment as ~~a Computational~~an Expressive Order.

~~Computational~~~~Expressive~~ Orders have four components: 1) Bidder Logic: static functions that take data and return execution instructions. ~~All~~ External Users approved to use the Expressive Bidding Service may provide their Bidder Logic via the mechanism described in Part III Item 5 under "ORDER AND BIDDER LOGIC SUBMISSION"; 2) Bidder Inputs: data provided by Subscribers (for example, notional maximum values or symbol ratios/weightings) for use in ~~Computational~~~~Expressive~~ Orders. Bidder Inputs are provided as a FIX tag and may be specified on any Target Order entered in connection with a ~~Computational~~~~Expressive~~ Order; 3) Market Inputs: market data (e.g. the NBBO) supplied by the Operator as an input to Bidder Logic (see Part III Item 23); 4) Target Orders: Limit Orders (including Midpoint Peg Orders) submitted by Subscribers via FIX that reference Submitted Bidder Logic upon which such Bidder Logic acts.

BIDDER LOGIC SUBMISSION: Bidder Logic is expressed via computer code in a general-purpose programming language. ~~External Users (e.g. ReasonML). A person using the Expressive Bidding Service~~ must submit its Submitted Bidder Logic in advance of its use in any ~~Computational~~~~Expressive~~ Order. Bidder Logic is available for use on the first trading day after the calendar day of its receipt by the ATS. The ATS and the programming language itself are sufficiently flexible to allow External Users to create their own constraints that suit their execution objectives, using common mathematical and Boolean constraints. Examples are provided below. ~~External Users of the service, as authors of any Bidder Logic, can submit such code to the ATS through the Portal~~ or, in the case of Subscribers specifically, through FIX messages as an alternative. As detailed in Part III Item 5, Bidder Logic is not itself an order, and orders themselves can only be submitted directly to the ATS by Subscribers. Examples of computations that may be performed using Bidder Logic: (and full examples illustrated below in this section):

- Measurement of bid/ask spread and volume imbalance;
- Computation of midpoint prices with custom volume / venue weightings;
- Selection of a subset of stocks (i.e. underlying Target Orders) for participation or elimination;
- Further constraining of prices / quantities expressed in Target Orders to less aggressive levels;
- Selection betweenExpressing indifference across different quantity levels at different price points;
- Requiring execution in multiple stocks simultaneously, or else none at all;

The output of any Bidder Logic is similar to a collection of Boolean constraints (e.g. “AND,” “OR”) and algebraic constraints (e.g. +, *, <, =), acting on prices and/or quantities for different symbols. For example, a constraint $\text{Quantity}(A) > 0 \text{ AND } \text{Quantity}(B) > 0$ would require that the quantity filled in symbol “A” must be greater than 0 and the quantity filled in symbol “B” must also be greater than 0. A similar, more restrictive constraint would be $\text{Quantity}(A) = \text{Quantity}(B)$ meaning the share quantity in both symbols must be equal. Either case would represent an intent to “only execute a trade in A if also executing a trade in B.” If the constraint cannot be met in the auction, the ComputationalExpressive Order will not be filled in either A or B.

Upon acceptance, each Bidder Logic submission is systematically evaluated to confirm its properties (e.g. that it can successfully terminate), then assigned a unique reference ID, which is provided back to the user, for inclusion in Target Orders. The Portal provides tools for analyzing and testing properties of Bidder Logic such as the execution instructions that result from the application of specific simulated Bidder Inputs and Market Inputs to the Bidder Logic. Bidder Inputs and Market Inputs are specific to order entry and matching, and are not managed through the Portal. Target Orders are always sent via FIX and must be received by the ATS from Subscribers.

As an illustrative example of execution instructions that are possible with Computational OrdersExpressive Bidding, an order seeking to buy three securities in any ratio, up to a total notional amount, would consist of: 1) Bidder Logic (External User controlled): instructions in the form of a computer program to buy any combination of symbols provided as an input to the program (the Bidder Inputs), each at prices less than or equal to their NBBO midpoints (the Market Inputs) up to a fixed notional cap (also specified as a Bidder Input); 2) Bidder Inputs (External User controlled): a list of symbols e.g. (“A”, “B”, “C”) and a notional cap e.g. \$500,000.00 included as a FIX tag on one of the Target Orders; 3) Market Inputs (Operator controlled): The NBBO of “A”, “B”, and “C” as determined by the procedure described in Part III Item 23; 4) Target Orders (External User controlled): three underlying Limit Orders to buy “A”, “B”, and “C” respectively with corresponding limit prices and maximum volumes;

The FIX message for entering this order would contain an identifier referencing the pre-submitted Bidder Logic, as well as Bidder Inputs. The Bidder Logic would provide for the computation of midpoint prices for each symbol using the Market Inputs provided by the Operator at the time of auction (as described in Part III Item 23). Additional examples of trading objectives that may be expressed using Computational OrdersExpressive Bidding are given below. These examples include constraints and computations which would, in practice, be constructed and submitted as Bidder Logic. These constraints and computations are shown in a reduced form analogous to Bidder Logic (i.e. a more easily readable format than the programming language used in actual Bidder Logic) to illustrate how Computational OrdersExpressive Bidding may be used. In practice, additional constraints for each example may be included to manage combinations of, for example, price, quantity, and or notional limits.

EXAMPLE A: Basket of Substitutes: A trader may have equal preference for one or more stocks in a Bidder supplied list that similarly satisfy some investment objective, e.g.: buy any combination of A, B, and/or C up to a total notional maximum of \$1,000,000.

Constraint 1 (notional maximum):

$$\text{Quantity(A)} * \text{Price(A)} + \text{Quantity(B)} * \text{Price(B)} + \text{Quantity(C)} * \text{Price(C)} \leq \$1,000,000$$

EXAMPLE B: “One out of Many” Basket: A trader may wish to transact in only one out of a list of stocks: buy only stock A or stock B, up to the price and quantity limits specified on the underlying Target Orders. The quantities in Constraint 1 are set at > 0 without an upper limit because the trader is relying on the quantity specified in the Target Orders to establish the maximum size of the order.

Constraint 1 (one out of many):

$$\text{Quantity(A)} > 0 \text{ XOR } \text{Quantity(B)} > 0$$

Note: “XOR” refers to exclusive-or, a logical operation that can be interpreted as “one or the other, but not both”. Sequences of multiple other constraints can be used to create similar behavior for 3 or more stocks.

EXAMPLE C: Basket of Complements: A trader may wish to transact if and only if they can do so in multiple stocks simultaneously, e.g.: sell (A and B and C) in equal quantities as a single basket. In this example, each unit of the basket (i.e. 1 share of A, 1 share of B, and 1 share of C) must be sold for a sum of at least \$100, or N units for $N * \$100$ (all units of a given basket will have the same price, as auctions clear each symbol at a single price). Alternatively, the quantities for A, B, and C may be expressed as a desired ratio, e.g. reflecting the market capitalization or price per share of the stocks.

Constraint 1A (equal quantities):

$$\text{Quantity(A)} = \text{Quantity(B)} = \text{Quantity(C)}$$

Constraint 1B (quantity ratio):

$$2 * \text{Quantity(A)} = 10 * \text{Quantity(B)} = 15 * \text{Quantity(C)}$$

Constraint 2 (minimum price per unit):

$$\text{Price(A)} + \text{Price(B)} + \text{Price(C)} \geq \$100$$

EXAMPLE D: Pairs / Hedge Trade: A trader may wish to transact in two different symbols in similar amounts: buy A if and only if selling an approximately equal (within \$1,000) notional amount of B.

Constraint 1 (both A and B simultaneously):

$$\text{Quantity(A)} > 0 \text{ AND } \text{Quantity(B)} > 0$$

Constraint 2 (maximum net notional of +/- \$1,000):

$$-\$1,000 < (\text{Price}(A) * \text{Quantity}(A) - \text{Price}(B) * \text{Quantity}(B)) < \$1,000$$

Note: side (buy/sell) for A and B would be expressed in the underlying Target Orders. Additional logic could be constructed to identify and select buy vs. sell side Target Orders for participation if Target Orders were provided for both sides.

EXAMPLE E: Dollar Neutral Basket: A trader may wish to purchase and sell a mix of stocks such that the notional amount sold is equal or approximately equal to the notional amount purchased.

Constraint 1 (maximum net notional of +/- \$100)

$$-\$100 \leq (\text{Notional}(A) + \text{Notional}(B) + \text{Notional}(C)) - (\text{Notional}(D) + \text{Notional}(E) + \text{Notional}(F)) \leq \$100$$

It is assumed for simplicity that A, B, and C have corresponding Target Orders to BUY and D, E, and F have corresponding Target Orders to SELL (or vice versa). This can be validated and asserted by the BiddingBidder Logic, or the BiddingBidder Logic can analyze the input Target Orders and arrange the terms of the constraint according to each Target Order's side.

EXAMPLE F: Price Improvement Size-Up: A trader may wish to transact different volumes at different prices: sell up to 500 shares at \$20, or sell up to 1,000 shares if the price is more favorable at \$21, but not both (i.e. not 1,500 total). This is an example of a ComputationalExpressive Order that is employed for a single stock.

Constraint 1:

$$(0 \leq \text{Quantity}(A) \leq 500 \text{ AND } \text{Price}(A) > \$20) \text{ XOR } (500 < \text{Quantity}(A) \leq 1,000 \text{ AND } \text{Price}(A) > \$21)$$

EXAMPLE G: Imbalance Discretion: A trader may wish to defer the single stock execution decision between bidding at the midpoint price or at a more aggressive price until the time of auction, based on external market conditions measured by the ATS via the SIP and made available as Market Inputs. For example, a trader might wish to enter an order on the following basis: if there is at least twice as much exogenous volume available at the national best offer (NBO) than is available at the national best bid (NBB), then buy 100 shares up to the NBO. Otherwise, buy 100 only up to the midpoint.

Computation on Market Inputs: IF NBO_Volume(A) / NBB_Volume(A) > 2.0 THEN dynamic_price = NBO(A) OTHERWISE dynamic_price = Midpoint(A)

Constraint 1 (set dynamic limit price):

$$\text{Price}(A) \leq \text{dynamic_price}$$

For ComputationalOrdersExpressive Bidding, both the parameters of all constituent Target Orders (e.g. limit price) and the constraints provided in Bidder Logic must be satisfied for an execution to occur. Bidder Logic cannot permit an execution that would violate the parameters of the Target Order(s); likewise, Target Order parameters cannot permit an

execution that would violate constraints provided in Bidder Logic. For example: a ~~Computational~~An Expressive Order with Bidder Logic specifying willingness to execute multiple orders at the calculated midpoint or better, will not execute if dependent on inclusion of a Target Order whose limit price is less aggressive than the calculated midpoint and the clearing price of the auction.

ORDER AVAILABILITY: The ATS uses periodic call auctions that make use of mathematical optimization techniques to match buyers and sellers. These auctions take place multiple times per second throughout the trading day. Each auction considers all eligible orders across all symbols simultaneously and seeks an “optimal” matching between buyers and sellers as described in Part III Item 11. All order types, including ~~Computational~~Expressive Orders, are available to all Subscribers of the ATS, and have the same eligibility criteria and time cut-offs for participation in a given auction. ~~Computational~~Expressive Orders are evaluated (i.e. Bidder Logic code is processed) in each auction prior to the start of the auction’s optimization process. Given that ~~Computational~~Expressive Orders could allow for varying degrees of complexity, their evaluation is resource constrained. That is, each ~~Computational~~Expressive Order is allocated a finite amount of computation resources and is evaluated prior to the commencement of the Match Optimization process described in Part III Item 11 under the Auction Procedure heading. These computational constraints apply to all ~~Computational~~Expressive Orders equally (i.e. regardless of order complexity or from whom the ATS received the order). A ~~Computational~~An Expressive Order and its associated Target Orders will not be eligible for the auction if the ~~Computational~~Expressive Order exceeds its evaluation constraints. Subscribers can opt-in to receive message alerts via FIX that their orders did not participate in a given auction. The ATS provides tools ~~as~~ for analyzing the complexity and resource utilization of ~~Computational Orders~~Expressive Bidding.

ORDER PRIORITY: The ATS periodically holds auctions (multiple times per second) designed to seek an optimal matching between buyers and sellers across all eligible orders. Each order’s eligibility for participation is determined by its time-stamped receipt at one of the Operator’s distributed PoPs (the Operator is commencing operation with a single PoP, in Equinix NY5). Executions, allocations, and per symbol clearing prices are determined using mathematical optimization techniques, maximizing Aggregate Price Improvement dollars across eligible orders in a given auction. See Part III Item 11 under the Distributed Point of Presence System and Auction Procedure headings for specific details.

EXECUTION INSTRUCTIONS: The ATS supports a set of execution instructions applicable to both of its Standard Order types (Limit Orders and Midpoint Peg Orders) at the FIX layer. These execution instructions also apply to the Target Orders that are used in connection with ~~Computational Orders~~Expressive Bidding. Subscribers may use these execution instructions on a per order basis, subject to system bounds established and imposed by the ATS itself as described in Part III Item 8. The following execution instructions are available: 1) Price Limit (minimum price verification on a per-share basis); 2) Maximum number of shares; 3) Minimum number of shares (available on orders for more than 100 shares); 4) Time-in-force: Day, Immediate or Cancel, Fill or Kill, Good ’Til Date (with an expire time not to exceed the end of the current trading session);

These message-layer constraints cannot be overridden by ~~Computational Order~~Expressive Bidding and Bidder Logic.

ORDER CANCELLATION, MODIFICATION, AND REPLACEMENT: the ATS does not support modification of resting orders, but Subscribers can cancel and replace orders with either a single cancel-replace request or two separate cancellation and new order entry requests. Order entry and cancellation requests are processed as described in Part III Item 11(c).

ROUTING: The ATS does not route orders to other trading centers.

The ATS does not support any order types designed not to remove liquidity, as the ATS does not distinguish between providing and removing liquidity.

Are the terms and conditions for each order type and attribute the same for all Subscribers and the Broker-Dealer Operator?

Y

If no, identify and explain any differences.

Item 3.11: Trading Services, Facilities and Rules

Provide a summary of the structure of the NMS Stock ATS marketplace (e.g., crossing system, auction market, limit order matching book) and explain the means and facilities for bringing together the orders of multiple buyers and sellers on the NMS Stock ATS.

MATCHING SYSTEM: Rather than matching orders continuously as they arrive at the matching engine (as in a continuous limit order book) the ATS periodically holds auctions designed to seek an optimal matching between buyers and sellers across all eligible orders. As part of this mechanism, Subscribers can enter Limit Orders or Midpoint Peg Orders in single securities or, by the use of Computational Orders Expressive Bidding, specify execution instructions that span multiple one or more securities. Computational Orders allow Expressive Bidding allows External Users to express constraints on one order or a group of related orders to fit their business specific execution and or risk management objectives. For example, a Computational an Expressive Order may enforce an aggregate limit on notional dollars transacted across simultaneous executions in orders for multiple securities, in addition to price and quantity limits on those individual orders. As explained in Part III Item 7, Computational Orders Expressive Order are comprised of Target Orders sent via FIX by Subscribers; Bidder Logic (computer code specifying constraints); Bidder Inputs to complement the Bidder Logic as it may apply to a given Target Order, and Market Inputs (i.e. Market Data). Auctions are multilateral: one or more buyers can match against one or more sellers. Within a given auction the mechanism computes per-security uniform transaction prices that apply to all buyers and sellers of that security. The ATS matching mechanism is a call auction in that order matching happens at a specific point in time. All NMS stocks are eligible to trade in the ATS, subject to procedures described in Part III Item 10 (Opening Procedure).

DISTRIBUTED POINT OF PRESENCE SYSTEM: The Operator maintains a distributed and time-synchronized PoP system at multiple data centers for order entry and market data intake (see also Item III, Part 5 above for further information on the PoP system). Although matching happens at a centralized location, Subscribers can enter orders at any PoP. PoP arrival timestamps dictate order eligibility. Orders received at a PoP by a Cutoff Timestamp (the “Cutoff” or “Cutoff Time”) selected by the ATS for a given auction are eligible for matching in that auction; orders received after the Cutoff are not eligible until the next auction. By using PoP arrival timestamps (rather than matching engine arrival timestamp) as described below, the distributed PoP system endeavors to promote equality of access to Subscribers with systems located in different geographies. The Operator is commencing operation of the ATS with a single PoP in Equinix NY5 at 800 Secaucus Road, Secaucus, New Jersey 07094.

ORDER ENTRY AND EXECUTION PROCESS: PoPs apply high precision (recorded in nanoseconds) timestamps to orders as they arrive. After receiving a timestamp, orders proceed to the matching engine located at Equinix NY5 in Secaucus, NJ. Orders are eligible for all auctions with a Cutoff Time greater than or equal to their PoP timestamp. The Cutoff Time is also used as a basis for computing NBBO (see Part III Item 23). Aside from the

determination of orders' eligibility, the auctions have no notion of time priority (i.e. all orders participating in the same auction are on parity from a time perspective). Price priority and share allocation proceeds per the mechanism described in Part III Item 11(c).

Because orders require time to propagate from their entry PoP to the matching engine, the matching engine pauses for a duration (the "Buffer Window" or "Buffer") long enough to allow the arrival of market data from the SIP as well as orders from all PoPs before commencing an auction. The duration of the Buffer Window is calibrated based on measured historical and real-time network latencies and may change over time but will remain on the order of milliseconds or tens of milliseconds. This Buffer seeks to prevent orders entered at PoPs further (in the sense of network transmission time) from the matching engine from experiencing a time disadvantage relative to PoPs closer to the matching engine. Execution report dissemination uses a similar system as described in Part III Item 21.

Are the means and facilities required to be identified in Item 11(a) the same for all Subscribers and the Broker-Dealer Operator?

Y

If no, identify and explain any differences.

Explain the established, non-discretionary rules and procedures of the NMS Stock ATS, including order interaction rules for the priority, pricing methodologies, allocation, matching, and execution of orders and trading interest, and other procedures governing trading, such as price improvement functionality, price protection mechanisms, short sales, locked-crossed markets, the handling of execution errors, and the time-stamping of orders and executions.

~~AUCTION PROCEDURE: the~~ The core mechanism underlying execution on the ATS is the combinatorial call auction process. This auction process uses a matching optimization formula that considers orders in all securities in a given auction simultaneously in an effort to identify mutually beneficial matches between buyers and sellers across the ATS's entire market.

AUCTION PROCEDURE: In summary, auctions consist of the following steps: 1) "Initialization Time": an auction Cutoff Time (as defined in the following paragraph) is randomly chosen per the procedure described below as the start of an auction; 2) "Auction Network Buffer" (or "Buffer"): this Buffer is intended to allow orders and market data enough time to arrive from distant PoPs as described in Part III Item 11(a). More specifically, the Buffer allows sufficient time for orders and market data to arrive from the furthest (measured in network transmission time) PoP from the matching engine. The length of the Buffer can vary based on expected transmission times, but would typically be on the order of milliseconds or tens of milliseconds; 3) "Match Optimization": ATS systems evaluate ~~Computational~~Expressive Orders and run the combinatorial matching process,

which determines prices and share allocations across all symbols; 4) “Post Auction Network Buffer”: upon completion of the Match Optimization process, the matching engine broadcasts auction results to all PoPs. Each PoP waits until a pre-determined time (which always precedes the following auction’s Cutoff), to distribute execution reports, thereby providing a synchronized dissemination of such data externally. As with the Auction Network Buffer, the length of the Post Auction Network Buffer can vary based on expected transmission times, but would typically be on the order of milliseconds or tens of milliseconds; 5) “Data Dissemination”: at the conclusion of the Post Auction Network Buffer period, PoPs communicate auction results in the form of execution reports to external parties, including Subscribers, the ATS’s direct clearing provider, and the Trade Reporting Facility.

The complete lifecycle of these steps spans a timescale of less than 100 milliseconds. Auctions occur at discrete “Cutoff Times”, following the completion of the prior auction lifecycle, drawn at random within a range of 20 milliseconds to 200 milliseconds from the previous auction. When the Auction Network Buffer has elapsed, the matching engine establishes order eligibility per the PoP arrival timestamps as described in Part III Item 11(a). At this point, Market Inputs used by ComputationalExpressive Orders and the data used for constructing NBBO is final. See Part III Item 23 under MEASUREMENT OF MARKET DATA AND NBBO for a detailed explanation of NBBO construction. All ATS timestamps, including those that appear on execution/trade reports, are recorded in nanoseconds.

ORDER ELIGIBILITY: Orders entered into the ATS are “firm.” Subscribers can send cancellation requests for resting orders. Cancellation requests received and timestamped before the Cutoff Time have immediate effect. Cancellation requests received after the Cutoff Time but before the completion of the auction cycle do not have effect until the following cycle (and therefore the order may still participate in the auction notwithstanding the cancellation request). The order entry system removes the referenced order from the matching engine as soon as the next auction window opens if the order is still present (not filled) and rejects it otherwise. With regards to a partial fill, the residual quantity is treated as the maximum fill quantity for the order in subsequent auctions, unless its time-in-force instructions dictate that it be cancelled.

RISK CONTROLS: After determining order eligibility (per Part 3 Item 11(a)) and selecting market data (per Part 3 Item 23) upon the completion of the Auction Network Buffer, the ATS carries out a series of pre-match market quality and risk checks. These consist of testing for locked and crossed markets (rules for trading during locked and crossed markets follow later in this section), verifying that user configured risk checks pass, and flagging “clearly erroneous orders” as ineligible. For Subscriber controlled risk checks, the following parameters are configurable within the bounds established by the ATS (see Part III Items 7 and 8 for minimum and maximum values): 1) Total notional value maximums per order; 2) Total quantity maximums per order; 3) Symbol restrictions; 4) Short sale restrictions; 5) Self-Trade prevention by MPID and/or FIX session;

As an additional risk control, orders with External User-supplied prices 10% or more aggressive than the NBBO are not eligible for participation. Subscribers cannot configure

~~this behavior and the~~The ATS rejects orders for which this is true at the time of submission. ~~Subscribers can configure this behavior to be more restrictive (i.e. less than 10%) but not less restrictive (i.e. greater than 10%).~~ The ATS may also enforce share quantity and notional value constraints according to maximums put in place by the ATS's clearing provider.

MATCH OPTIMIZATION: After identifying a set of eligible, risk checked orders, matching can proceed. Matching is conducted via a uniform clearing price combinatorial auction - a form of mathematical optimization that attempts to match one or more buyers with one or more sellers in a fashion that maximizes the chosen objective(s) while enforcing constraints. Because orders can include constraints that span securities (e.g., buy A if and only if an accompanying order for B gets filled) the optimization process must run over all securities simultaneously. The optimization procedure includes a rule that the solution found must respect the constraints placed on orders by participants (e.g. price limits, volume ratios) as well as the market wide constraints placed by the ATS (e.g., ensuring that aggregate buy fill volume equals aggregate sell fill volume on a security-by-security basis).

The ATS optimization process attempts to maximize the following two objectives: 1) **Aggregate Price Improvement:** the optimization attempts to maximize the total price improvement realized across all orders eligible to participate in the auction, incorporating both price per share and number of shares filled. For an individual order to buy or sell a single security, "Price Improvement Dollars" refers to the difference between the limit price on the order and the auction clearing price (i.e. the price at which the order is filled) for the given security, times the quantity filled. For ~~a Computational~~an Expressive Order to buy and/or sell multiple securities simultaneously, price improvement refers to differences in limit prices and clearing prices for each respective security, summed across all securities times the quantities filled. See below under "Priority and Price Formation Example" for information on treatment of NBBO. When considering a crossed buy and sell order for a security, Price Improvement Dollars can be calculated as the difference between limit prices for the two orders. Aggregate Price Improvement represents the sum of Price Improvement Dollars across all eligible orders under consideration for a given optimization solution, and across all securities. As a result, it is possible that an order (i.e. Standard Order or ~~Computational~~Expressive Order) may receive lower match priority in favor of ~~a Computational~~an Expressive Order containing a less aggressively priced Target Order in the same security. This can occur if and only if prioritizing the less aggressive order results in greater Aggregate Price Improvement to a given auction (see a specific example lower in this section under heading: Priority And Price Formation Example). In other words, maximizing Aggregate Price Improvement is the dominant and first objective of the optimization. 2) **Volume:** as a secondary objective, the optimization attempts to maximize the total share volume cleared in aggregate across all securities.

These two objectives are evaluated in succession. The solution with the highest value of the first objective is selected. In the event multiple solutions have an equal value for the first objective, the solution with the highest value of the second objective is selected. A solution that represents the largest value of the objective function possible is known as globally optimal. Given finite computing resources obtaining globally optimal solutions is not always possible. Furthermore, globally optimal solutions are not always unique in that

multiple solutions might yield identical values for the optimization objective. The ATS is designed such that solutions: a) do not violate constraints placed on orders by users or the global constraints placed by the ATS, such as those described below under “LOCKED AND CROSSED MARKETS” and those in Part III Item 20; and b) are optimal amongst the solutions explored during the optimization process. In the event that multiple candidates are equally optimal (i.e., have equal values for both the first and second objectives), a candidate in the set of equally optimal outcomes is randomly selected.

Once a solution to the optimization is identified, clearing prices are determined for each symbol. A solution to the optimization represents a matching of buyers to sellers for which it is possible to find a list of per-security auction clearing prices (the “price vector”). For a given auction, all orders selected for participation via the solution to the optimization receive fills at the same clearing price on a per-security basis. A given output to the optimization might yield more than one possible set of clearing prices (solution). When more than one possible set of clearing prices is identified, the ATS then uses a secondary procedure that seeks to identify distinct per-security clearing prices that are as close to at the per-security midpoints middle of NBBO as possible the feasible range of clearing prices. In the absence of a two-sided quote (measured as described in Part III Item 23) the optimizer uses the last trade price (also measured as described in Part III Item 23) instead of the midpoint. The optimization solution represents a matching of buyers and sellers and is the mechanism for establishing order priority and share allocation.

When orders with identical sets of constraints enter the auction (e.g. Limit Orders for the same security at the same limit price with no further constraints) the optimizer treats them as components of a single, larger “synthetic” order. When the chosen solution results in a partially filled synthetic order (i.e. when there is insufficient volume on the contra side to fill the entire synthetic order), allocation to constituent orders happens via a round-robin mechanism. Round-robin allocation is equivalent to: 1) Assigning a random sequencing to all constituent orders; 2) Allocating 100 shares at a time to constituent orders according to the random sequence, honoring all constraints (e.g. maximum quantity); 3) Repeating step 2 above until the supply of available contra shares runs out.

In the case where only Limit Orders and Midpoint Peg Orders with no further constraints (i.e. beyond price / quantity constraints) are eligible to participate for a given security (in a given auction), the ATS preserves price priority in that security match process behaves the same as described above.

ADDITIONAL DETAILS ON OPTIMIZATION: Combinatorial auctions belong to a class of computationally intensive search and optimization tasks known as non-deterministic polynomial-time (NP) hard problems. Given that problem instances (auctions) could allow for varying degrees of complexity and therefore computational requirements, they cannot always be exhaustively evaluated. Accordingly, the ATS uses time and resource bounded optimization techniques whereby computational resources are utilized over a period of time lasting on the order of 10s of milliseconds. The amount of resources to be used for a given auction optimization cycle is fixed a priori and arrived at without knowledge of the orders participating in a given auction cycle. Between auctions, the total amount of resources available for optimization may fluctuate as a function of historical and expected

future need for computational resources. While these optimization techniques are intended to improve the efficacy of the matching process, they might not identify a globally optimal solution in every scenario. Specifically, the optimizer makes decisions about the allocation of finite computing resources to exploring subsets of the solution space in ways that might leave portions of the search space unexplored.

To ensure that the optimization techniques utilized by the ATS do not result in a “worse” overall outcome for Subscribers than if the ATS utilized individual security-by-security order books for matching securities, every auction includes a “lower bounding” procedure. The lower bounding procedure is deterministic and works by computing the value of the hierarchical objective strictly considering the components of Limit Orders, Mid-Point Peg Orders and ~~Computational~~Expressive Orders free of constraints spanning multiple securities. This produces a similar set of outcomes as a traditional per-security call auction would if it were to use a similar matching objective. As such, it places a deterministic lower bound on the performance of the optimization. A solution found through this deterministic search process is selected if it provides greater Aggregate Price Improvement than other solutions found by the optimization process.

PRIORITY AND PRICE FORMATION EXAMPLE: An illustrative example of the ATS optimization, order priority, and price assignment procedure follows. ~~Computational~~OrderExpressive Bidding constraints are expressed in a similar reduced form to the examples above.

SELLERS' ORDERS: 1) Seller S1: ~~A Computational~~An Expressive Order (including Target Orders) detailed just below 2) Seller S2: Sell C, LIMIT 500 @ \$23

Seller S1 ~~Bidding~~Bidder Logic: - Constraint 1: all quantities must be equal: Quantity(A) = Quantity(B) = Quantity(C) - Constraint 2: total basket price must be at least \$110: Price(A) + Price(B) + Price(C) >= \$110

Seller S1 Target Orders: 1) Sell A, LIMIT 500 @ \$52; 2) Sell B, LIMIT 500 @ \$30; 3) Sell C, LIMIT 500 @ \$25;

BUYERS' ORDERS: 1) Buyer B1: Buy A, LIMIT 100 @ \$54; 2) Buyer B2: Buy B, LIMIT 100 @ \$34; 3) Buyer B3: Buy C, LIMIT 100 @ \$27;

In this example, Seller S2 would not receive a fill because despite pricing its order more aggressively than Seller S1 (\$23 vs. \$25), filling Seller S1 would result in greater Aggregate Price Improvement and therefore represents a more optimal solution under the ATS's defined auction procedure. This is demonstrated in the matching arrangement below. See above for more information regarding the matching objective function. Matching would occur as follows: 1) Symbol A: Buyer B1 <> Seller S1, 100 shares; 2) Symbol B: Buyer B2 <> Seller S1, 100 shares; 3) Symbol C: Buyer B3 <> Seller S1, 100 shares;

Aggregate Price Improvement for this arrangement is calculated as:

$$100 * (\$54 - \$52) + 100 * (\$34 - \$30) + 100 * (\$27 - \$25) = \$800$$

Note that execution prices are not assigned until one or more arrangements maximizing the first optimization objective (Aggregate Price Improvement) has been found. However, this calculation does take into account Bidder Logic constraints. This arrangement will only be considered if it permits potential execution prices that satisfy Bidder Logic constraints. In this case, quantities are equal and there are multiple price vectors that sum to greater than \$110, so the arrangement can satisfy Seller S1's Bidder Logic constraints.

Consider an alternative auction outcome in which Seller S2 is included. Including Seller S2 exhausts the 100 shares of demand for C, leaving 0 shares of C for Seller S1. Because Seller S1 must receive equal quantities of each symbol under its first Bidder Logic constraint, Seller S1 is unable to transact in A and B despite having priced its orders such that it may cross with Buyer B1 and Buyer B2 respectively. And because Seller S1's orders in A and B cannot be executed, Buyer B1 and Buyer B2 are also not able to transact, despite having priced their orders such that a cross is possible in A and B.

The matching arrangement including Seller S1 is chosen by the objective function because it provides \$800 of Aggregate Price Improvement, which is greater than the \$400 ($100 * (\$27 - \$23)$) provided in a matching arrangement where Seller S2 does participate (in which case only Symbol C is transacted).

Note: for the purpose of calculating Aggregate Price Improvement, orders with Limit Prices outside the opposite NBBO measured by the ATS as described in Part III Item 23 are considered to be priced at the NBBNBO (for Buy orders) or NBONBB (for Sell orders).

This example illustrates the property of Aggregate Price Improvement where a more aggressively priced order in a single security (from Seller S2) would, in this example case, receive lower match priority in favor of an order for multiple securities (from Seller S1), despite the latter order offering a less aggressive price in the given security. This is possible in cases where another participating order contributes as much or more Aggregate Price Improvement to the auction. The goal of Aggregate Price Improvement is to encourage overall market-wide liquidity formation by considering both price and quantity across all orders, in all securities, simultaneously (rather than price alone on a security-by-security basis) as the primary factor dictating priority.

To expand this comparison further, consider an example similar to the above, but in which Seller S1 entered less aggressive prices with only \$1 of price improvement between Seller S1's target orders and the Buyers' orders in their respective securities. The aggregate price improvement contributed would be substantially lower: $100 * \$1 * 3 = \300 . Because the matching arrangement including Seller S2 and not Seller S1 offers \$400 of Aggregate Price Improvement, Seller S2's order would be selected to participate and Seller S1 would not participate.

EXECUTION PRICE FORMATION: With regards to execution price selection: after selecting the first matching arrangement in the example above, an execution price for each symbol is determined. Any price in the range between the Seller's limit prices and the respective Buyers' limit prices is equally optimal (i.e. clears the same volume). In such a case, "midpoint affinity", which refers to selecting the midpoint of the NBB Orange of feasible clearing prices when all else is equal, (i.e. constraints are satisfied and objective

function values are equal), is used as a tie-breaker in each symbol. The auction clears as follows: 1) Execute 100 A @ \$53; 2) Execute 100 B @ \$32; 3) Execute 100 C @ \$26;

LOCKED AND CROSSED MARKETS: The ATS flags securities as locked or crossed at the start of each auction using the NBBO “snapshot” created using the procedure described in Part III Item 23(a) “MEASUREMENT OF MARKET DATA AND NBBO.” Because the time scales on which auctions run (10s of milliseconds) are much longer than the duration of a typical locked market (< 100 microseconds) the ATS allows Subscribers to specify via a port level setting if their orders for locked securities should remain eligible for the auction.

Subscribers making this election might receive executions during a locked market. The ATS does not execute trades in crossed securities as measured by the process described in Part III Item 23. Securities that were not crossed at the time of measurement (i.e. at the Cutoff Time) but become crossed during the auction may still receive fills.

EXECUTION ERRORS: The Operator maintains Written Supervisory Procedures that include procedures for handling execution errors. Execution errors may be the result, for example, of an ATS system failure, an error on the part of an ATS Subscriber, or an error in data (e.g. NBBO) provided to the ATS and used in executing a trade. In any of these cases, ATS personnel contact all Subscribers party to the transaction or transactions affected by the error and determine the appropriate course of action. If all Subscribers party to the trade wish to keep the trade in place and applicable FINRA, SEC, and SRO rules allow, no action is taken and the trade is processed. If one or more of the Subscribers wishes to break or correct a trade, the Operator may accordingly cancel or issue corrections for erroneous trades. If the Operator determines a transaction to be a bona fide error, the Operator may in its sole discretion accept erroneous legs of a transaction into an error account maintained with the Operator’s clearing provider. The Operator promptly trades out of any positions it takes into the error account via execution services offered by its clearing provider. The CCO reviews all activity in the Operator’s error account on a monthly basis to ensure that the account maintains a zero balance and that the account is only used for bona fide errors.

Are the established, non-discretionary rules and procedures required to be identified in Item 11(c) the same for all Subscribers and the Broker-Dealer Operator?

Y

If no, identify and explain any differences.

Item 3.19: Fees

Identify and describe any fees or charges for use of the NMS Stock ATS services, including the type of fees (e.g., subscription, connectivity), the structure of the fees (e.g., fixed, volume-based, transaction-based), variables that impact the fees (e.g., types of securities traded, block orders, form of connectivity to the ATS), differentiation among types of Subscribers (e.g., broker-dealers, institutional investors, retail) and range of fees (e.g., high and low).

The fees charged for use of the ATS are calculated on a per-share basis. For every share matched, the ATS charges a fixed fee to each counterparty. The fee is the same for all types of transactions, except where the same Subscriber provides both the buy and sell side of a trade (for example, when the Subscriber is matching two customer orders against each other). Exact fees are ~~maintained on the ATS website and are~~ \$0.00080009 per share, and \$0.00030004 per share for Subscribers providing both the buy and sell side of a trade (i.e. \$0.00060008 in total per share). However, for an introductory period, the length of which is determined by the Operator, fees for all Subscribers, for all activity, are \$0.00020000 per share, per side.

The commission structure is the same for all Subscribers. The ATS does not ~~currently~~ offer volume-based or tiered pricing.

In addition to the ATS's fees, the ATS passes through to Subscribers certain clearing and regulatory fees (e.g. NSCC, FINRA Section 3 fees and Trading Activity Fees) it is assessed.

The ATS does not charge Subscribers for network connectivity, access, or execution data. Nor does the ATS compute different fees based on the type or content of orders executed.

Identify and describe any fees or charges for use of the NMS Stock ATS services that are bundled with the Subscriber's use of non-ATS services or products offered by the Broker-Dealer Operator or its Affiliates, including a summary of the bundled services and products, the structure of the fee, variables that impact the fee, differentiation among types of Subscribers, and range of fees.

No such fees are charged; no additional services are bundled with the use of the ATS.

Identify and describe any rebate or discount of fees or charges required to be identified in Items 19(a) and 19(b), including the type of rebate or discount, structure of the rebate or discount, variables that impact the rebate or discount, differentiation among types of Subscribers, and range of rebate or discount.

No rebates or discounts are available.

Item 3.20: Suspension of Trading

Explain any procedures for suspending or stopping trading on the NMS Stock ATS, including the suspension of trading in individual NMS stocks.

LIMIT-UP LIMIT-DOWN ("LULD"): the ATS continuously monitors LULD bands via the Securities Information Processor (SIP) consolidated feeds and does not execute trades outside of those price bands.

As with the establishment of NBBO, the ATS processes trading halt information relative to the start of each auction - the Initialization Time per Part III Item 11(c). When news of a trading halt for a given security arrives via SIP, the ATS removes that symbol from consideration with immediate effect if an auction has not yet started, and in the next auction cycle if an auction is in progress. ~~Computational~~Expressive Orders including Target Orders for a halted security can still receive executions on Target Orders for non-halted symbols to the extent that the Bidder Logic allows. In the event that a circuit-breaker has been triggered for a given security, the ATS does not accept "short" orders in that security unless they are marked "short exempt."

The ATS may impose additional trading halts in one or more securities if the ATS approaches trading volume thresholds defined in Regulation Systems Compliance and Integrity ("Reg SCI"). The Operator performs monthly reviews of trading volume in an effort to anticipate a requirement for compliance with Reg SCI.

ERROR CONDITIONS: The ATS may also suspend trading temporarily if it detects certain Error Conditions that materially impact its ability to match trades. These Error Conditions are defined in the Operator's Business Continuity Plan and include: loss or material degradation of communication between the matching engine and one or more PoPs; matching engine system errors; loss or material degradation of communication between market data sources and the matching engine; loss of connectivity with the Trade Reporting Facility. When an Error Condition is detected, the ATS may suspend trading as follows:

- 1) If an Error Condition is detected between auctions, i.e. prior to a chosen Cutoff Time but after the Data Dissemination of the previous auction, the auction may be delayed until the Error Condition is resolved;
- 2) If an Error Condition is detected during an auction, i.e. after a Cutoff Time has elapsed but before the subsequent Data Dissemination is complete, no executions are reported for that auction and the subsequent auction may be delayed until the Error Condition is resolved.

Are the procedures for suspending or stopping trading the same for all Subscribers and the Broker-Dealer Operator?

Y

If no, identify and explain any differences.

Item 3.21: Trade Reporting

Explain any procedures and material arrangements for reporting transactions on the NMS Stock ATS, including where an ATS reports transactions and under what circumstances.

The ATS reports transactions as follows: 1) Execution reports to Subscribers; 2) Trade Reporting Facility (TRF) reports (sent to the FINRA/NYSE TRF); 3) Clearing reports to the ATS's clearing provider; 4) Rule 605, Rule 606, ~~0~~ATSCAT, and ATS-R Reports (sent to FINRA); 5) Drop Copy reports upon Subscriber request:

After each auction, execution reports are transmitted to each Subscriber reflecting their individual participation (fills, partial fills, "leaves") in the auction. These reports contain, for each order that participated in the auction: symbol, clearing price, volume filled, and side (buy or sell). In the case of a partial fill the execution report contains a "Leaves Quantity" field representing the remaining shares available to be filled for the order.

Modifications made to orders are acknowledged within execution reports. This includes cancellations and automatic adjustments made by the ATS (such as automatically reducing max volume constraints in response a partial fill, as described above).

To foster equal access across all geographies the ATS disseminates execution reports from PoPs at the same time (as detailed in Auction Procedure within Part III Item 11).

Because of the time required for the Buffer Period and match optimization process, some amount of time will elapse between the measurement of NBBO and the dissemination of data to Subscribers and the TRF (i.e. the full completion of the Auction Procedure). This amount of time can vary based on technical factors and limitations but typically falls within 10s of milliseconds.

In compliance with Reg NMS Rule 601 and the FINRA Rule 6000 series, the ATS also promptly transmits aggregate price and volume information for each security matched to the FINRA/NYSE TRF after the Post-Auction Network Buffering period described in Part III Item 11(c) has elapsed at the conclusion of each auction. TRF reports consist, for each security, of a single price and total volume transacted for the given auction.

Promptly after execution reports and TRF reports are transmitted the ATS transmits fully disclosed clearing reports to its direct clearing provider.

In accordance with Reg NMS Rules 605 and 606 the ATS provides periodic reports to FINRA regarding the composition and timing of orders entered and executed on the ATS. ~~0~~ATSCAT reports are filed on a daily basis, reporting all trades for which the ATS is the designated reporting party. This includes orders received from Subscribers and volume matched internally to the ATS.

Are the procedures and material arrangements for reporting transactions on the NMS Stock ATS the same for all Subscribers and the Broker-Dealer Operator?

Y

If no, identify and explain any differences.

Item 3.23: Market Data

Identify the sources of market data used by the NMS Stock ATS (e.g., proprietary feed from a national securities exchange, feed from the securities information processor (SIP)), and how the ATS uses market data from these sources to provide the services that it offers, including how the ATS uses market data to determine the NBBO and protected quotes, and display, price, prioritize, execute, and remove orders and trading interest on the ATS.

The ATS makes use of external market data (including NBBO) from the Securities Information Processor ("SIP") to: 1) Determine the prices at which pegged orders are eligible for participation; 2) Evaluate ~~Computational~~ Expressive Orders that rely on external market data received by the ATS; 3) Determine the prices at which each security in the auction clear; 4) Maintain compliance with the Regulation NMS Order Protection Rule.

NBBO FOR PRICE CONSTRAINTS: The ATS treats Midpoint Peg Orders as Limit Orders with dynamically computed limit prices. Thus, unless specified otherwise as ~~a Computational Order~~ an Expressive Bidding constraint, Midpoint Peg Orders are eligible for price improvement when the computed clearing price for the security is more aggressive than the midpoint.

~~Computational Orders~~ Expressive Bids can also specify computations based on Market Inputs, which consist of the measured NBBO and other market data. This functionality endeavors to provide all Subscribers' orders with a single, consistent view of market conditions. The following are examples of how Bidder Logic can use Market Inputs: 1) Specify limit prices based on NBBO (e.g. set a price limit to a specified amount higher or lower than NBBO); 2) Compute a momentary volume-weighted average price for a security, based on data from away venues; 3) Specify a bid price for a security as a function of the price of one or more other securities;

NBBO FOR ORDER PROTECTION RULE COMPLIANCE: The ATS match procedure takes the national best bid and national best offer for a given security as lower and upper bounds (constraints) on the allowable clearing price for that security. If no clearing price within the measured NBBO results in a match for a security, the auction will not execute a trade in that security. The ATS runs multiple auctions per second, and as such the ATS reports all transactions within less than one second of measuring NBBO.

MEASUREMENT OF MARKET DATA AND NBBO: The ATS constructs a view of NBBO from data provided by the SIP. Each SIP message contains a timestamp provided by the reporting exchange representing when that exchange processed the given message (the "Exchange Timestamp"). The ATS market data and matching systems use these Exchange Timestamps in an effort to construct a consistent time-aligned view of the market. The NBBO prices used in the auction are the ones most recent to but not after the Initialization Time. Below is an illustrative example of this procedure: 1) Auction Initialization results in a Cutoff Time; 2) Auction Network Buffering allows data to propagate from exchanges, to the SIP, and ultimately to the ATS; 3) After buffering the ATS computes NBBO for each

tradable symbol by processing all messages from the SIP with Exchange Timestamps less than or equal to the Cutoff Time for the auction. The Exchange Timestamp for a given record is the same on the record for an event received through the SIP and the record for the same event received through lower latency proprietary direct feeds. The ATS does not subscribe to direct feeds from the national exchanges. However, the Auction Network Buffering Period is typically substantially more than the difference in latency between the SIP data feeds and the exchange direct feeds.

The Operator uses a combination of time reference sources and statistical processing techniques to survey and correct inter-exchange clock synchronization issues and delays or cancels auctions during periods when the ATS market data systems flag national exchange timestamps as potentially anomalous (See ERROR CONDITIONS in Part III Item 20).

Are the sources of market data and how the NMS Stock ATS uses market data for the services that it offers the same for all Subscribers and the Broker-Dealer Operator?

Y

If no, identify and explain any differences.

Primary Business Name: ONECHRONOS**BD Number: 286322****BD - AMENDMENT****04/14/2022****BD - DIRECT OWNERS/EXECUTIVE OFFICERS**Are there any indirect owners of the *applicant* required to be reported on Schedule B?☒ **Yes** ☐ **No****Ownership Codes: NA - less than 5% B - 10% but less than 25% D - 50% but less than 75%****A - 5% but less than 10% C - 25% but less than 50% E - 75% or more**

Full Legal Name	DE/FE/I	Title or Status	Date Acquired	Own. Code	Control Person	PR	CRD #(or S.S.No., IRS Tax #, Emp. ID)
DAN, BERNARD WILLIAM	I	CEO	12/2016	NA	Y	N	2421761
DORSEY, MICHAEL THOMAS	I	CHIEF COMPLIANCE OFFICER	03/2022	NA	Y	N	2560077
DOYLE, KEVIN	I	DIRECTOR	12/2016	NA	N	N	xxx-xx-xxxx
HARPEL, JEFFREY KEITH	I	FINOP, PRINCIPAL FINANCIAL OFFICER, PRINCIPAL OPERATIONS OFFICER	04/2017	NA	N	N	1367784
Johnson, Stephen David	I	DIRECTOR, CHIEF COMPLIANCE OFFICER DIRECTOR	12/2016	NA	Y	N	xxx-xx-xxxx
LITTLEPAGE, KELLY C	I	DIRECTOR	12/2016	NA	Y	N	xxx-xx-xxxx
OCX GROUP INC	DE	SOLE MEMBER	12/2016	E	Y	N	47-4149392
SUTH, RICHARD JR	I	DIRECTOR	03/2017	NA	N	N	2164733